

May 29, 2000

## **NEER Grant: DE-FG07-98ID13632**

**Title:** Reactor whole core transport calculations without fuel assembly homogenization

**Investigator:** Nicholas Tsoulfanidis, University of Missouri-Rolla

**Co-Investigator:** Elmer Lewis, Northwestern University

**Phase 2 period:** 9-1-99 to 8-31-00

**Funding:** \$80,473

**Objectives:** Spherical harmonics and/or simplified spherical harmonics are to be incorporated into the 2-dimensional formulation in which fuel pin cell and fuel assembly homogenization are eliminated.

Benchmarking against Monte Carlo solutions is being performed.

**Phase 2 results:** A two-dimensional form of a finite element formulation of VARIANT has been created and used to perform pin cell and assembly calculations in which neither fuel pin cell or fuel assembly homogenization are required. Refinements of the angular variable ( $P_1$  to  $P_5$ ), the nodal interface approximation (1<sup>st</sup> to 5<sup>th</sup> order), the triangular finite element grid, and the source approximation (lumped to consistent) have been tested and convergence was verified. Comparisons indicating the relative value of nodalization at the fuel pin cell level vs. nodalization at the fuel assembly level have been documented.

Benchmarking calculations using MCNP and VIM have been utilized to examine discretization errors in the finite element formulation of VARIANT.

**Phase 3 period:** 9-1-00 to 8-31-01

**Funding:** \$83,665

**Objectives:** The methods developed during the first two phases will be generalized and implemented for 3-D geometries. The VARIANT structure will be reordered to facilitate implementation of 3-D computations.

Benchmarking calculations will again be performed.

**Phase 3 expected results:** All the algorithms that will be generated will be tested and benchmarked to assure the accuracy of the computations. Computational efficiencies will be examined. The results will be presented in appropriate journal articles; necessary user documentation for the codes will be written.

Attached are copies of two presentations made at international conferences, based on this work and a “best paper” award for one of the presentations.